LEEM study of the dynamics of solid state dewetting

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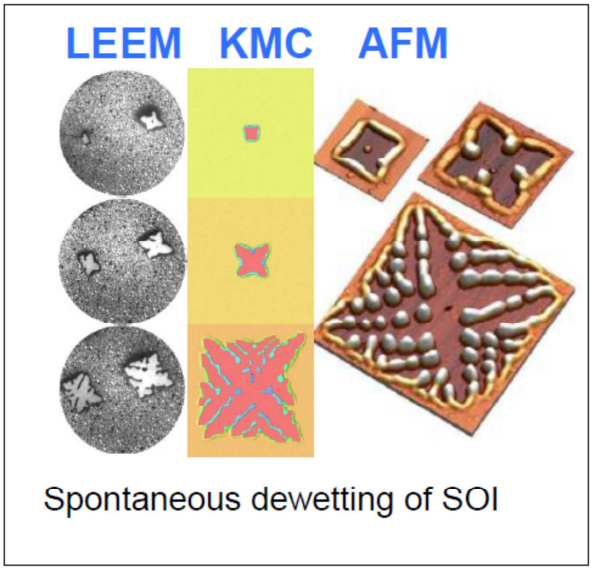
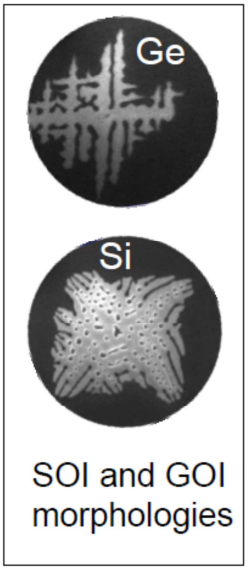
Using low-energy electron microscopy (LEEM), we have studied, in-situ and in real time, the dewetting of Si(001) and Ge(001) thin films on amorphous silicon dioxide substrates [1-7]

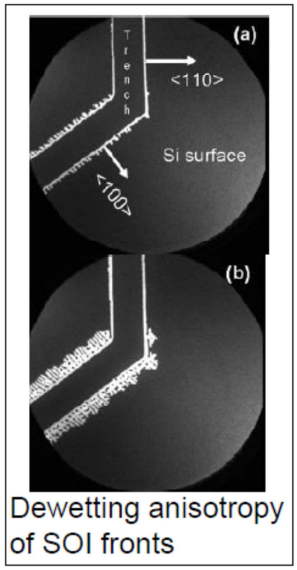
-Spontaneous dewetting proceeds by void growth with formation of elongated fingers that subsequently break apart forming an assembly of self-organized three-dimensional (3D) nanocrystals. The dewetting scenarios have been reported in [1,2]. Dewetting experimental morphologies and dewetting kinetics have been compared to kinetic Monte Carlo simulations (incorporating surface and interfacial free energies) [1].

-Studying the dewetting from artificial fronts (obtained by lithography) enables us to analyze the stability conditions of a dewetting front [3]. The stability of a dewetting edge is governed by the presence or the absence of atomically flat facets along the receding front. In case of Ge, the presence of {15 3 23} facets leads to a modification of the dewetting morphology from squared-void (for Si) to more dendritic-like (for Ge) [4,5]. In both cases analytic 2D and 3D models based on simple approximate geometries of the dewetting front have been developed and used to extract specific activation energies from experiments [1-6].

-Finally we show that dewetting can be controlled to form well-ordered 3D crystals [5] (by means of well-selected artificial fronts) or to avoid it. For instance, dewetting of Si thin film on SiO_2 can be reversibly inhibited by exposing the Si surface to a partial pressure of dioxygen [7].







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